

System Advisor Model Battery Storage



Presenter: Nick DiOrio

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Outline

- Overview of battery model
- Battery financial inputs
- Battery technical performance
- Battery dispatch
- Validation
- Demonstration
- Q & A

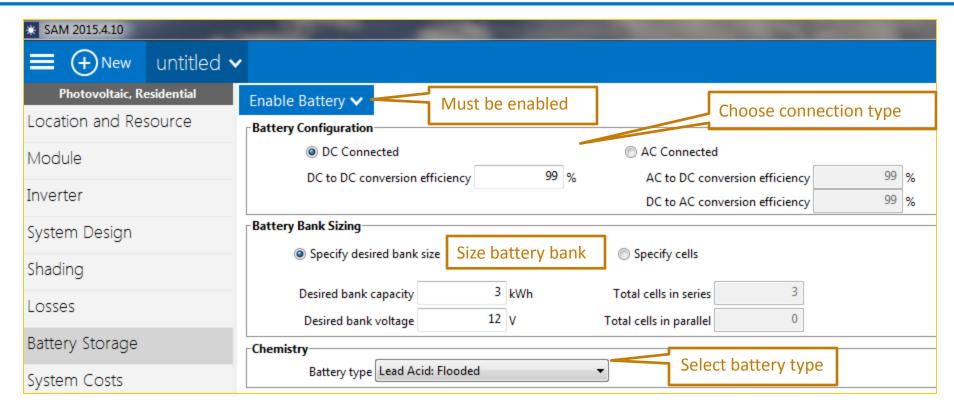
Model Overview

- Techno-economic model for residential, commercial, and third-party ownership system
 - AC & DC system configurations
 - Lead acid & lithium ion battery chemistries
 - System lifetime analysis including battery replacement costs
 - Models for terminal voltage, capacity, temperature
 - Manual dispatch controller

Battery Financials

- Upfront & replacement costs
 - Battery bank capacity [kWh] * price [\$/kWh]
- User specified replacement criteria
 - When max capacity is n % of original maximum
- Escalation/De-escalation above inflation
 - Model changing battery replacement costs over time
- System lifetime analysis
 - Single year does not capture complexity of battery replacements

Battery Performance



- Minimum necessary inputs for battery performance
- Other inputs can be populated by accepting defaults for battery chemistry type or manually input

Battery Dispatch

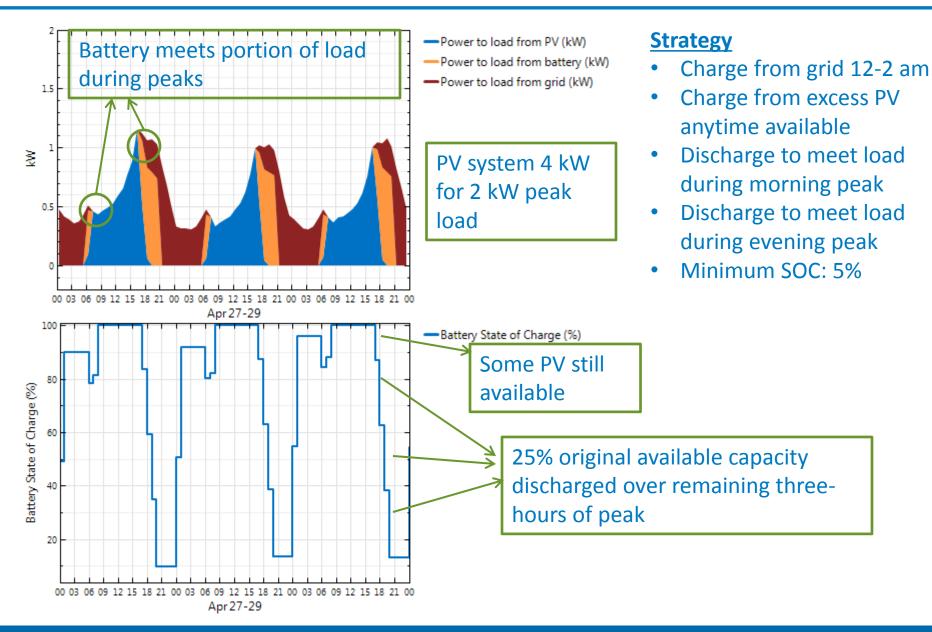
of load is used to charge the battery. Use the timing controls above to put

constraints on the battery controller. See help for more details.

	Charge from grid	Charge from PV	Allow discharging	% capacity to discharge		12am	1am	2am	Sam 4am	Sam	6am	7am	8am	9am	10am	12pm	1pm	2pm	3pm	4pm	5pm	pbm	/pm	9pm	10pm
					Jan	2	2	1 1	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3	3 3	3 3	1	1
Period 1:		√		25 %	Feb	2	2	1 1	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3	3 :	3 3	1	1
D : 12				25 04	Mar	2	2	1 1	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3	3 :	3 3	1	1
Period 2:	V	✓		25 %	Apr	2	2	1 1	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3	3 ;	3 3	1	1
Period 3:		V	✓	25 %	May	2	2	1 1	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3	3 :	3 3	1	1
Period 4:		V	V	50 %	Jun	2	2	1 1	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3	3 :	3 3	1	1
renou 4.				30 /6	Jul	2	2	1 1	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3	3 :	3 3	1	1
Minimum state of charge		E 0/		Aug	2	2	1 1	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3	3 ;	3 3	1	1	
		5 %		Sep	2	2	1 1	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3	3 ;	3 3	1	1	
Minimum tin	ne at charge st	tate	10 min		Oct 2 2 1 1 1 1 4 4 1 1 1 1 1 1 1 1 3 3 3		3 3	1	1																
	_				Nov	2	2	1 1	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3 3 3 3		1	1	
fault, the batter	ry controller ai	ms to mini	mize energy pu	rchases from the	Dec	2	2	1 4	1 1	1	4	4	1	1	1 1	1	1	1	1	1	3	3 :	3 3	1	1

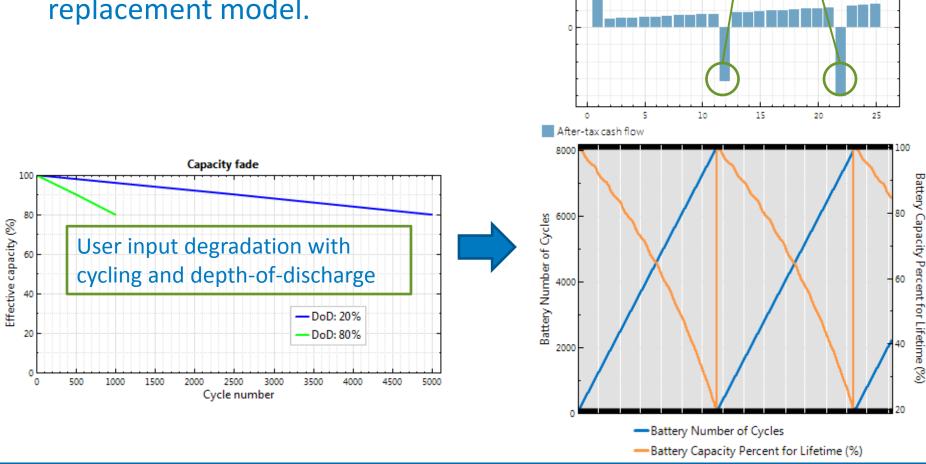
- Can specify when to charge from grid, pv, and discharge, and max energy to discharge
- Limits for minimum state-of-charge, rapid oscillations

Dispatch Visualization



Lifetime degradation and financials

 User input dispatch strategy, degradation, replacement criteria and costs result in tailorable replacement model.



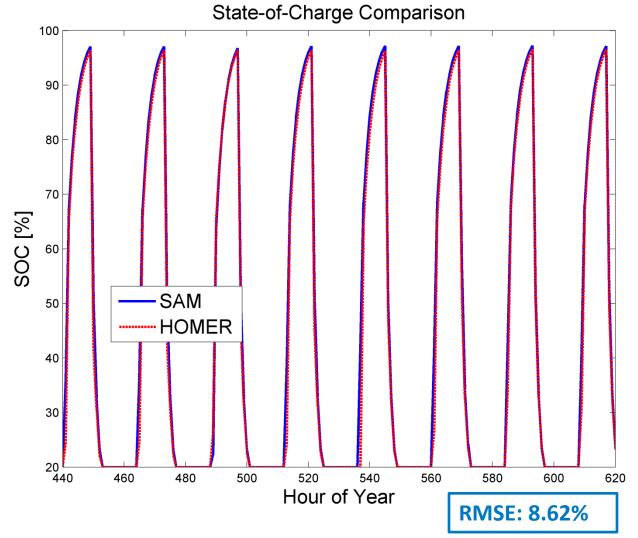
5000

After Tax Cash Flow-System Lifetime

Battery replacements

result in additional costs

HOMER Performance Comparison



System

- PV: 3.875 kWdc
- Inverter: 4.000 kWac
- Location: Phoenix, AZ
- Same load profile
- UPG UBGC2 AGM Lead-Acid Battery (1.2 kWh)

Energy discharged

- Full SAM model results in 23% less energy discharged to load.
- Disabling SAM thermal and lifetime models gives results within 3% of HOMER.

Demonstration

Question: How could I model the benefit of adding batteries to PV for a home in Honolulu, HI?

Steps:

- 1. Create a detailed PV case with Residential financial model
- 2. Input details about location, PV system, battery system
- 3. Tailor dispatch strategy to electricity rates
- 4. Compare payoff period to no-battery case





Questions?